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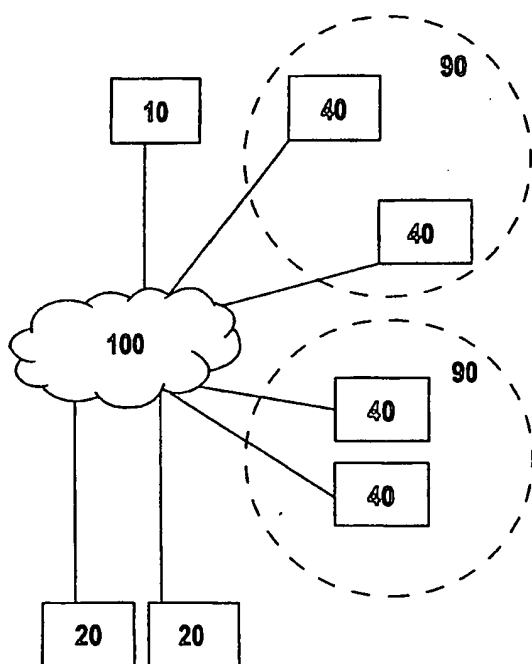
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(54) Title: IRRIGATION CONTROL SYSTEM



(57) Abstract: A method for remote management of a plural-
ity of irrigation sites (90, 90) associated with clients who are re-
sponsible for the management of the sites (90, 90), each site (90)
having one or more controllers (40, 40) adapted to turn on/off
switching devices for irrigation equipment within the site (90),
each controller (40) being adapted to execute a controller program
and having controller memory for storing the controller program,
the method comprising: (a) receiving from one of the clients, and
storing in a host computer system (10), parameters for a site man-
agement program for one of the sites (90, 90) with which the client
is associated, the preferred method of communication being the in-
ternet (100); (b) generating a controller program for each con-
troller (40) of the site (90), the controller program being adapted
to implement the controller's (40) role in the site management
program for the site (90); (c) transmitting the controller programs
to the respective controller memories of the controllers (40, 40);
and (d) communicating with the controllers (40, 40) to initiate
execution of the controller programs in accordance with the site
management programs.

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Irrigation control system

Field of the invention

The invention relates to an irrigation control system for remote management (including programming and/or control) of irrigation sites. More particularly the invention relates to a
5 control system for remote management of switching devices for irrigation equipment.

Background of the invention

It is known to provide remote control of site-installed irrigation equipment. However, the known methods generally require the person responsible for the management of the irrigation site to operate and maintain suitable hardware and/or software to effect the
10 remote control. With the increasing complexity of computer systems there is a need to provide a more efficient system of remote control whereby the person responsible for the management of the irrigation site is not required to operate and maintain, or to operate and maintain as much, hardware and/or software to effect the remote control.

Summary of the invention

15 According to an aspect of the present invention, there is provided a method for remote management of a plurality of irrigation sites associated with clients who are responsible for the management of the sites, each site having one or more controllers adapted to switch switching devices for irrigation equipment within the site, each controller being adapted to execute a controller program and having controller memory for storing the controller
20 program, the method comprising:

- (a) receiving from at least one of the clients, and storing in a host computer system, parameters for a site management program for one of the sites with which the client is associated;
- (b) generating a controller program for each controller of the site, the controller
25 program being adapted to implement the controller's role in the site management program for the site;
- (c) transmitting the controller programs to the respective controller memories of the controllers; and
- (d) communicating with the controllers to initiate execution of the controller programs
30 in accordance with the site management programs.

The method enables clients responsible for one or more irrigation sites to outsource the responsibility for all or part of the hardware and/or software operation and maintenance that is necessary to effect remote control of switching devices for irrigation equipment within the client's site. In particular, the method may be operated as a service to clients
5 responsible for one or more sites.

In a preferred form of the present invention, the client may enter a website operated by the operator of the method to program, and/or reprogram, the site management program for the client's site or sites.

Any suitable form of switching device for irrigation equipment may be used. Typically,
10 the switching devices will include relays and/or triacs.

To enable a site management program to be manually overridden, the method may further comprise the step of communicating with a controller to halt execution of the controller's controller program following receipt of a stop command from a client responsible for the management of the site containing the controller, or from a or a person having the client's
15 authority to issue the stop command.

To enable a site management program to have additional functionality to the programs in the controllers, the method may further comprise the step of communicating with a controller to halt execution of the controller's controller program following the generation of a stop command by a computer system implementing a site management program for
20 the site containing the controller. Typically, the site management program may cause a stop command to be issued if rain is detected in the site.

It is desirable to enable the site management program to be readily amended. Accordingly, the method preferably further comprising the steps of receiving parameters in respect of amendments to a site management program for a site from the client responsible for the
25 management of the site or from a person having the client's authority to communicate the parameters, generating a new controller program for each controller of the site that is affected by the amendments, and transmitting the new controller programs to the respective controller memories.

In order to make the system secure, the method may further comprise the steps of
30 providing each client with a unique identifier, and receiving an identifier from a person

prior to implementing parameters received from the person to verify that the person is the client or has the authority of the client to communicate the parameters.

To readily enable clients to program the site management program, or to amend it, the method may further comprise the step of supplying the clients with software enabling the
5 clients to effect the communication of the parameters. This may be effected by enabling the client to download the software from a website operated by the operator of the method.

The site management program of the method may include variable control logic that is in dependence on external data. The external data may be, or include, meteorological data. It may be, or include, Doppler radar data.

10 According to another aspect of the present invention, there is provided a host computer system for remote management of a plurality of irrigation sites associated with clients who are responsible for the management of the sites, each site having one or more controllers adapted to switch switching devices for irrigation equipment within the site, each controller being adapted to execute a controller program and having controller memory for
15 storing the controller program, the host computer system servicing a plurality of clients and being adapted to communicate with the controllers and with client devices whereby to enable a client, or a person having the client's authority, to communicate parameters for a site management program to the host computer system from a client device, the host computer system being configured to store the site management program parameters for a
20 site and generate for each controller of the site a controller program that implements the controller's role in the site management program for the site, and to transmit the controller programs to the respective controller memories of the controllers, and to communicate with the controllers to initiate execution of the controller programs in accordance with the site management programs.

25 The client device may be any device suitable for communicating with the host computer system. Typically, the client device will be a personal computer. Preferably, the client device is adapted to communicate with the host computer system via the Internet. The client device may be a mobile telephone or the like.

The host computer system is preferably further configured to communicate with a
30 controller to halt execution of the controller's controller program following receipt of a

stop command from a client responsible for the management of the site containing the controller, or from a or a person having the client's authority to issue the stop command.

The host computer system is preferably further configured to communicate with a controller to halt execution of the controller's controller program following generation of a
5 stop command by the host computer system during execution of a site management program for the site containing the controller.

Preferably, the host computer system is also configured to:

- (a) receive parameters in respect of amendments to a site management program for a site from the client responsible for the management of the site or from a person
10 having the client's authority to communicate the parameters;
- (b) generate a new controller program for each controller of the site that is affected by the amendments; and
- (c) transmit the new controller programs to the respective controller memories.

The host computer system may be further configured to receive an identifier from a person
15 communicating with the host computer to verify that the person is the client or has the authority of the client to communicate with the host computer system.

Preferably the host computer system is further configured to supply the clients with software enabling the clients to effect the communication of the parameters.

The host computer system is preferably an Internet server.

20 The site management program in the host computer system preferably includes variable control logic that is in dependence on external data. The external data may be, or include, meteorological data. It may be, or include, Doppler radar data.

The present invention provides, in another aspect, a distributed system for remote management of a plurality of irrigation sites associated with clients who are responsible for
25 the management of the sites, the distributed system servicing a plurality of clients, the distributed system comprising switching devices for irrigation equipment within the sites, a host computer system, and a plurality of client devices for enabling clients to communicate with the host computer system, each site having one or more controllers adapted to switch the switching devices of the site, each controller being adapted to execute a controller
30 program and having controller memory for storing the controller program, the host

- computer system being adapted to communicate with the controllers, wherein the system is configured to enable a client, or a person having the authority of the client, to communicate parameters for a site management program to the host computer system from a client device, and wherein the host computer system, following receipt of the parameters,
- 5 generates for each controller of a site a controller program that implements the controller's role in the site management program, and transmits the controller programs to the respective controller memories, whereby to implement the site management program.

The host computer system of the distributed system is preferably further configured to communicate with a controller to halt execution of the controller's controller program

10 following receipt of a stop command from a client device.

The host computer system of the distributed system is preferably further configured to communicate with a controller to halt execution of the controller's controller program following generation of a stop command by the host computer system during execution of a site management program for the site containing the controller.

- 15 Preferably, the distributed system is further configured to:

- (a) enable a client, or a person having the authority of the client, to communicate parameters in respect of amendments to a site management program to the host computer system from a client device;
- (b) generate a new controller program for each controller of the site that is affected by
- 20 the amendments; and
- (c) transmit the new controller programs to the respective controller memories.

The distributed system may be further configured to enable a client, or a person having the authority of the client, to communicate an identifier to the host computer system using a client device, whereby to verify that the person is the client or has the authority of the

25 client to communicate with the host computer system.

The host computer system of the distributed system may be configured to supply the clients' client devices with software enabling the clients to effect the communication of the parameters to the host computer system.

Preferably, the host computer system of the distributed system is an Internet server.

The site management program of the distributed system may include variable control logic that operates in dependence on external data. The external data may be, or include, meteorological data. It may be, or include, Doppler radar data.

Description of the drawings

- 5 The invention will now be further explained and illustrated by reference to the accompanying drawings in which:

Figure 1 is a schematic diagram showing a distributed system in accordance with a preferred embodiment of the present invention; and

- 10 Figure 2 is a schematic diagram showing further components of the distributed system of figure 1 that are associated with one site.

Figure 1 shows a distributed system, shown generally at 1, for remote management of a plurality of irrigation sites 90 containing switching devices for irrigation equipment. Distributed system 1 includes a host computer system 10, a plurality of client devices 20 and a plurality of controllers 40 associated with sites 90 containing switching devices in the form of triacs 72. The host computer system 10, client devices 20 and controllers 40 are all connected to the Internet, shown generally at 100.

20 Figure 2 shows further components of the distributed system associated with an irrigation site 90. Controllers 40 include a control section 50 and an output section 70. Control section 50 includes a communications interface 52 for communicating with the Internet 100, controller memory 54, and a processing unit 56 for executing controller programs held in memory 54 or transmitted from host computer system 10.

Output section 70 of controllers 40 includes triacs 72 for irrigation equipment 82 that are operable by processing unit 56. Triacs 72 are connected via field wiring 80 to field-installed irrigation equipment 82 in the respective sites 90.

- 25 The field wiring 80 carries 24V AC.

Host computer system 10 provides an Internet site for access by clients of the operators of host computer system 10, referred to hereafter as "the host website". A client enters the host website by means of a client device 20 capable of communicating with the Internet. Typically, client devices 20 will be personal computers operated by a client. The host website is a secure area for creating or amending the site management program in respect

30

of a client's site. The host website requires the client, or a person authorised by the client, to enter a password or other suitable identifier to verify the client's (or other person's) right to enter the host website.

Upon entry to the host website, the client will be able to create, or amend, a site management program in respect of the client's site or sites. Following entry into the host website, host computer system 10 sends a copy of software to the relevant client device 20 enabling the client to produce the site management program (or to amend an existing site management program). The host computer system 10 also sends details of the site management program as presently held by the host computer system 10 to the client device 10 20 so that the client (or person authorised by the client) may verify the state of the site management program at any time.

The host computer system 10 generates a site management program (or amended site management program) in respect of the client's site, based on input of relevant parameters from the client. Suitable parameters defining the site management program include parameters relating to when particular items of irrigation equipment are to be switched on and off by the switching devices, the combinations of switching devices to be employed, and parameters defining the logic underlying the site management program, including the definition of switching programs depending on the occurrence of various contingencies. 15

Once the parameters defining the site management program (or amended site management program) have been generated, the host computer system 10 generates a controller program for each controller of the site that participates in the site management program. The host computer system 10 then transmits the controller programs to the respective controller memories 52 of the relevant controllers 40. 20

At the appropriate time or times, as defined by the site management program, the host computer system 10 communicates with the relevant controllers 40 to initiate execution of the controller programs. When the controller programs are executed by the relevant controllers 40, the roles of the relevant controllers 40 in the site management program for the sites are thereby implemented. 25

The site management program may be manually overridden by the client (or a person authorised by the client) by enabling the host computer system 10 to communicate with controllers 40 to halt execution of the controllers' controller program following receipt of a 30

stop command from a client (or authorised person) logged-on to the host computer system 10 by way of the host website.

The host computer system 10 is also configured so that a site management program can cause the host computer system 10 to communicate with controllers 40 to halt execution of the controllers' controller program following the generation of a stop command by the host computer system 10. For example, the site management program could generate a stop command or commands upon receipt of a signal indicating that rain is detected at the site or sites 90 in question.

The word 'comprising' and forms of the word 'comprising' as used in this description and in the claims does not limit the invention claimed to exclude any variants or additions. Modifications and improvements to the invention will be readily apparent to those skilled in the art. Such modifications and improvements are intended to be within the scope of this invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for remote management of a plurality of irrigation sites associated with clients who are responsible for the management of the sites, each site having one or more controllers adapted to switch switching devices for irrigation equipment within the site, each controller being adapted to execute a controller program and having controller memory for storing the controller program, the method comprising:
 - (a) receiving from at least one of the clients, and storing in a host computer system, parameters for a site management program for one of the sites with which the client is associated;
 - 10 (b) generating a controller program for each controller of the site, the controller program being adapted to implement the controller's role in the site management program for the site;
 - (c) transmitting the controller programs to the respective controller memories of the controllers; and
 - 15 (d) communicating with the controllers to initiate execution of the controller programs in accordance with the site management programs.
2. A method according to claim 1 further comprising the step of communicating with a controller to halt execution of the controller's controller program following receipt of a stop command from a client responsible for the management of the site containing the controller, or from a or a person having the client's authority to issue the stop command.
- 20 3. A method according to claim 1 or claim 2 further comprising the step of communicating with a controller to halt execution of the controller's controller program following the generation of a stop command by a computer system implementing a site management program for the site containing the controller.
- 25 4. A method according to any one of the preceding claims further comprising the steps of receiving parameters in respect of amendments to a site management program for a site from the client responsible for the management of the site or from a person having the client's authority to communicate the parameters, generating a new controller program for each controller of the site that is affected by the amendments, and transmitting the new controller programs to the respective controller memories.
- 30

5. A method according to any one of the preceding claims further comprising the steps of providing each client with a unique identifier, and receiving an identifier from a person prior to implementing parameters received from the person to verify that the person is the client or has the authority of the client to communicate the parameters.
- 5 6. A method according to any one of the preceding claims further comprising the step of supplying the clients with software enabling the clients to effect the communication of the parameters.
7. A method according to any one of the preceding claims wherein the site management program includes variable control logic that is in dependence on external data.
- 10 8. A method according to claim 7 wherein the external data is, or includes, meteorological data.
9. A method according to claim 7 wherein the external data is, or includes, Doppler radar data.
10. A method according to any one of the preceding claims substantially as described
15 herein with reference to the drawings.
11. A host computer system for remote management of a plurality of irrigation sites associated with clients who are responsible for the management of the sites, each site having one or more controllers adapted to switch switching devices for irrigation equipment within the site, each controller being adapted to execute a controller
20 program and having controller memory for storing the controller program, the host computer system servicing a plurality of clients and being adapted to communicate with the controllers and with client devices whereby to enable a client, or a person having the client's authority, to communicate parameters for a site management program to the host computer system from a client device, the host computer system
25 being configured to store the site management program parameters for a site and generate for each controller of the site a controller program that implements the controller's role in the site management program for the site, and to transmit the controller programs to the respective controller memories of the controllers, and to communicate with the controllers to initiate execution of the controller programs in
30 accordance with the site management programs.
12. A host computer system according to claim 11 further configured to communicate with a controller to halt execution of the controller's controller program following

receipt of a stop command from a client responsible for the management of the site containing the controller, or from a or a person having the client's authority to issue the stop command.

- 5 13. A host computer system according to claim 11 or claim 12 further configured to communicate with a controller to halt execution of the controller's controller program following generation of a stop command by the host computer system during execution of a site management program for the site containing the controller.
- 10 14. A host computer system according to any one of claims 11 to 13 further configured to:
- (a) receive parameters in respect of amendments to a site management program for a site from the client responsible for the management of the site or from a person having the client's authority to communicate the parameters;
 - (b) generate a new controller program for each controller of the site that is affected by the amendments; and
 - (c) transmit the new controller programs to the respective controller memories.
- 15 15. A host computer system according to any one of claims 11 to 14 further configured to receive an identifier from a person communicating with the host computer to verify that the person is the client or has the authority of the client to communicate with the host computer system.
- 20 16. A host computer system according to any one of claims 11 to 15 further configured to supply the clients with software enabling the clients to effect the communication of the parameters.
17. A host computer system according to any one of claims 11 to 16 further configured to be an Internet server.
- 25 18. A host computer system according to any one of claims 11 to 17 wherein the site management program includes variable control logic that is in dependence on external data.
19. A host computer system according to claim 18 wherein the external data is, or includes, meteorological data.
- 30 20. A host computer system according to claim 18 wherein the external data is, or includes, Doppler radar data.

21. A host computer system according to any one of claims 11 to 20 substantially as described herein with reference to the drawings.
22. A distributed system for remote management of a plurality of irrigation sites associated with clients who are responsible for the management of the sites, the distributed
5 system servicing a plurality of clients, the distributed system comprising switching devices for irrigation equipment within the sites, a host computer system, and a plurality of client devices for enabling clients to communicate with the host computer system, each site having one or more controllers adapted to switch the switching devices of the site, each controller being adapted to execute a controller program and
10 having controller memory for storing the controller program, the host computer system being adapted to communicate with the controllers, wherein the system is configured to enable a client, or a person having the authority of the client, to communicate parameters for a site management program to the host computer system from a client device, and wherein the host computer system, following receipt of the
15 parameters, generates for each controller of a site a controller program that implements the controller's role in the site management program, and transmits the controller programs to the respective controller memories, whereby to implement the site management program.
23. A distributed system according to claim 22 wherein the host computer system is
20 further configured to communicate with a controller to halt execution of the controller's controller program following receipt of a stop command from a client device.
24. A distributed system according to claim 22 or claim 23 wherein the host computer system is further configured to communicate with a controller to halt execution of the
25 controller's controller program following generation of a stop command by the host computer system during execution of a site management program for the site containing the controller.
25. A distributed system according to any one of claims 22 to 24 further configured to:
30 (a) enable a client, or a person having the authority of the client, to communicate parameters in respect of amendments to a site management program to the host computer system from a client device;

- (b) generate a new controller program for each controller of the site that is affected by the amendments; and
 - (c) transmit the new controller programs to the respective controller memories.
- 26. A distributed system according to any one of claims 22 to 25 further configured to
5 enable a client, or a person having the authority of the client, to communicate an identifier to the host computer system using a client device, whereby to verify that the person is the client or has the authority of the client to communicate with the host computer system.
- 27. A distributed system according to any one of claims 22 to 26 wherein the host
10 computer system is configured to supply the clients' client devices with software enabling the clients to effect the communication of the parameters to the host computer system.
- 28. A distributed system according to any one of claims 22 to 27 wherein the host computer system is an Internet server.
- 15 29. A distributed system according to any one of claims 22 to 28 wherein the site management program includes variable control logic that operates in dependence on external data.
- 30. A distributed system according to claim 29 wherein the external data is, or includes, meteorological data.
- 20 31. A distributed system according to claim 29 wherein the external data is, or includes, Doppler radar data.
- 32. A distributed system according to any one of claims 22 to 31 substantially as described herein with reference to the drawings.

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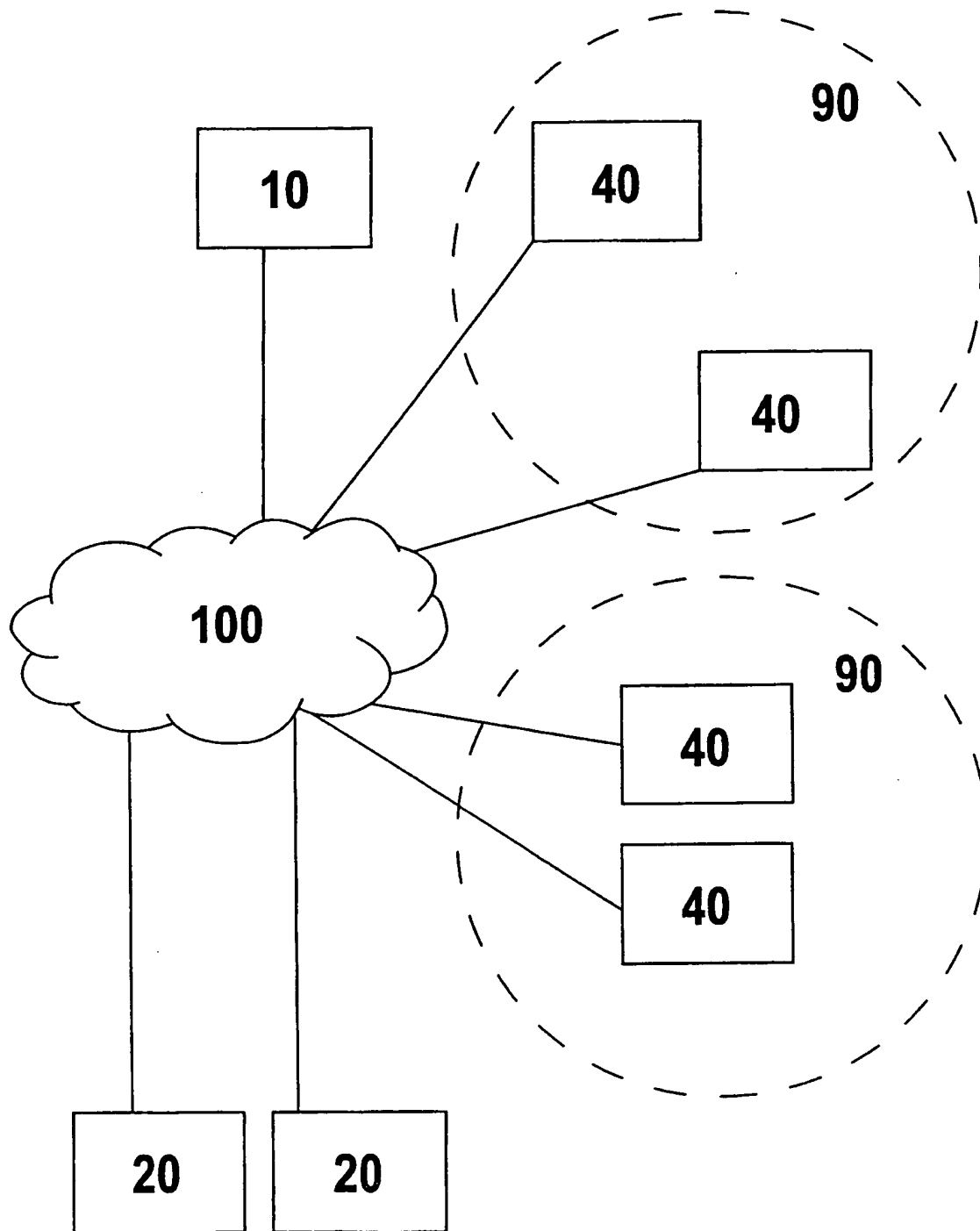


Figure 1

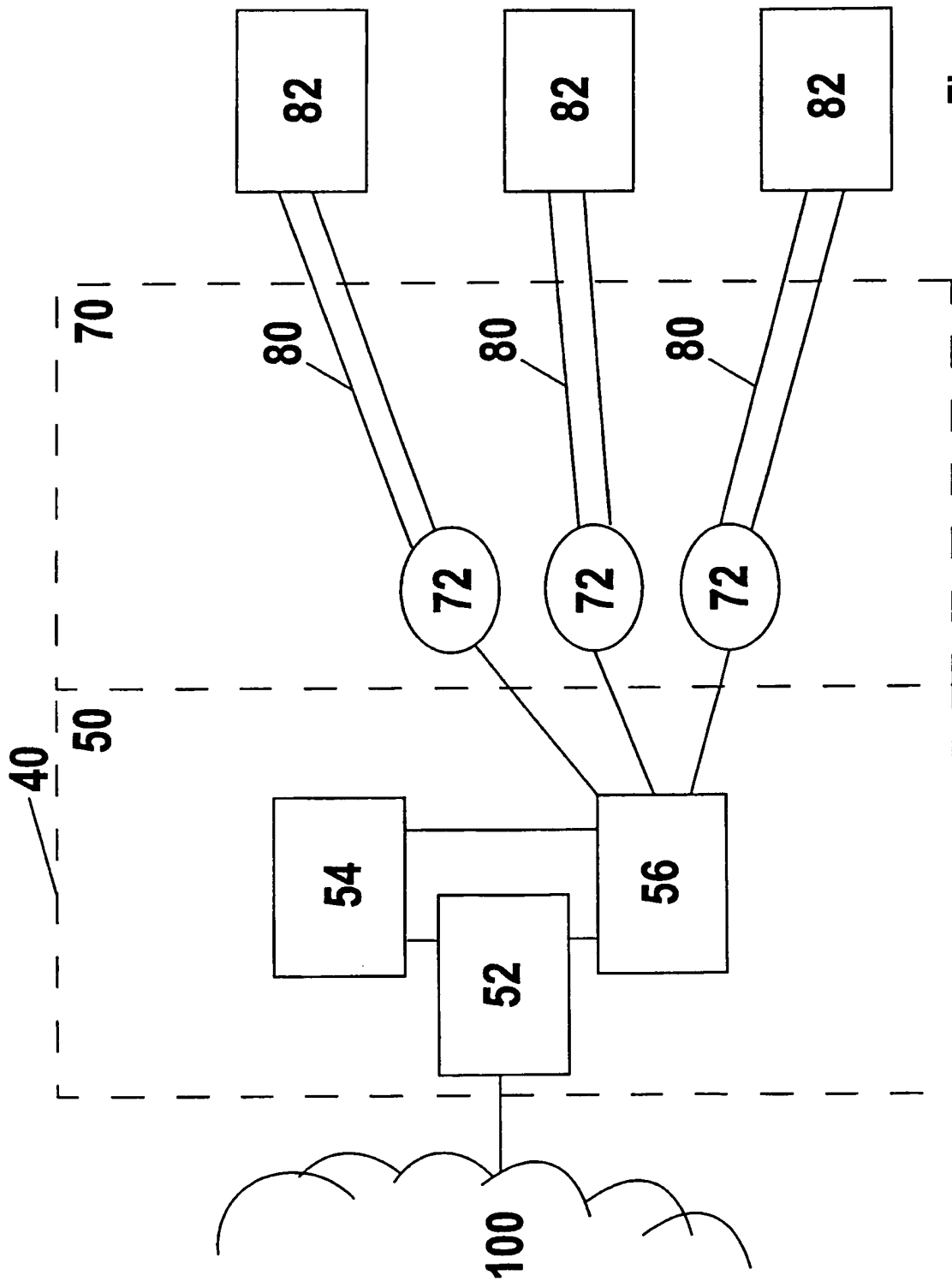


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER												
Int. Cl. ⁷ : G05B 15/00, 19/414; G06F 15/16, 17/60, 19/00; A01G 25/16												
According to International Patent Classification (IPC) or to both national classification and IPC												
B. FIELDS SEARCHED												
Minimum documentation searched (classification system followed by classification symbols) IPC: G05B 15/00, 19/414; G06F 15/16, 17/60, 19/00; A01G 25/16												
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched												
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DWPI, US DATABASE: with keywords (eg control, manage, irrigate, water)												
C. DOCUMENTS CONSIDERED TO BE RELEVANT												
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.										
X	WO 95/22799 A (WATERLINK SYSTEMS) 24 August 1995 Entire document	1-32										
X	US 4626984 A (UNRUH et al) 2 December 1986 Entire document	1-32										
X	WO 97/08942 A (SMART RAIN CORP.) 13 March 1997 Entire document	1-32										
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex												
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention											
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone											
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art											
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family											
"P" document published prior to the international filing date but later than the priority date claimed												
Date of the actual completion of the international search 25 October 2000		Date of mailing of the international search report - 6 NOV 2000										
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer A. SEN Telephone No : (02) 6283 2158										

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/01158

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 90/03724 A (SOLATROL) 19 April 1990 Entire document	1-32
X	WO 87/04275 A (AUDITEL SYSTEMS) 16 July 1987 Entire document	1-32
X	US 4760547 A (DUXBURY) 26 July 1988 Entire document	1-32

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